GPU Nuclear

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April 20, 1988
4410-88-L-0055/0373P

US Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

Dear Sirs:

Three Mile Island Nuclear Station, Unit 2 (TMI-2)
Operating License No. DPR-73
Docket No. 50-320
Nuclear Instrumentation

NRC letter NRC/TMI-88-008 dated March 9, 1988, transmitted three (3) comments in response to GPU Nuclear letter 4410-88-L-0009 dated February 10, 1988. The referenced GPU Nuclear letter proposed to use an alternate nuclear instrumentation system in the event that the installed nuclear instruments, specified in the current Technical Specifications, are rendered inoperable during planned plasma arc torch operations in the Reactor Vessel. The attachment provides a response to each NRC comment.

Sincerely,

F. R. Standerfer
Director, TMI-2

RDW/emf

Attachment

cc: Senior Resident Inspector, TMI - R. J. Conte
Regional Administrator, Region 1 - W. T. Russell
Director, Plant Directorate IV - J. F. Stolz
Systems Engineer, TMI Site - L. H. Thonus

NRC COMMENT 1

Provide a more detailed description of the alternate NI system including the sensitivity, range, reliability, and alarm capability.

GPU NUCLEAR RESPONSE

The alternate nuclear detector manufacturer is Reuter Stokes Corporation, subsidiary of the General Electric Company, which develops and provides nuclear monitoring systems to the nuclear industry.

The detectors that GPU Nuclear will employ in the alternate NI system are a fission counter/chamber type which will be used in the counting mode in low neutron flux fields. Neutron sensitivity is provided by concentric cylinders coated with uranium oxide. Aluminum is used in the construction of these cylinders to minimize neutron absorption and residual activation. The detector insulators are of a high purity alumina ceramic design intended to provide stable, long-term, noise-free operation of the detectors.

The detector specifications are as follows:

MAXIMUM RATINGS

Voltage	1000 Volts
Temperature	225°C
U-235 Load	3.56 Grams

TYPICAL OPERATING CHARACTERISTICS

As a Counter:	
Thermal Neutron Sensitivity	1.3 cps/nv $\pm$ 20%
Thermal Neutron Flux Range	.03 to 3 x 10^{+4}nv *
Voltage Range	200 to 900 V
Collection Time	$\underset{\sim}{\sim}$120 to 170 ns
As an Ionization Chamber:	
Thermal Neutron Sensitivity	1.8 x 10^{-13}amp/nv $\pm$20%
Gamma Sensitivity	8 x 10^{-11}amps/R/h $\pm$20%
Thermal Neutron Flux Range	$\underset{\sim}{\sim}10^5$ to 10^{11}nv

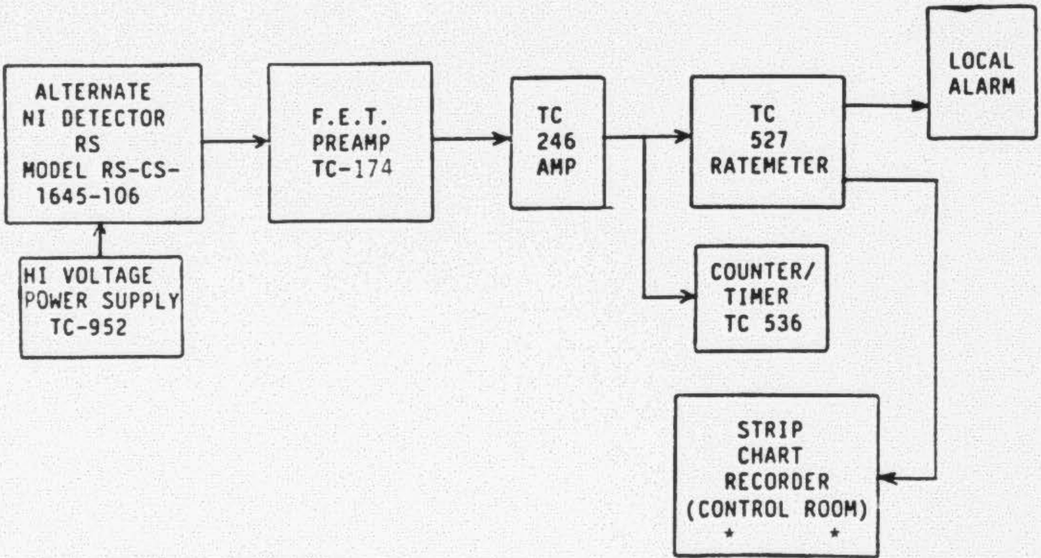
ELECTRICAL CHARACTERISTICS

Capacitance	450 pf
Resistance	$\geq 10^{12}$ohms

The detector readout equipment is supplied by Tennelec Incorporated. Tennelec also supplies radiation detection measuring and counting system equipment throughout the commercial nuclear power industry.

* nv (neutron flux) = $\frac{\text{neutron}}{\text{cm2} \cdot \text{sec}}$

The following block diagram illustrates the equipment that is being used for the alternate NI strings:



* Includes Alarm Indication

The TC 527 ratemeter is a stable, highly accurate device with simultaneous logarithmic and linear displays. Two scales are provided with the following ranges:

Logarithmic	10 to 10^{+8} cps
Linear	0 to 10^{+8} cps

The readout module also contains a built-in calibrator and a local audio alarm function with an adjustable threshold and variable tone for indication of count rate. Additionally, a remote strip chart recorder will be connected to the ratemeter and located in the Control Room. Alarm indication will also be provided in the Control Room to provide timely response to changes in the reactivity of the core. The detector and readout strings are connected via a General Electric radio frequency coaxial low capacitance cable to minimize noise induction.

NRC COMMENT 2

What actions do you plan to take if the alternate NI system is adversely affected by the plasma arc cutting unit?

GPU NUCLEAR RESPONSE

Should the alternate NI detectors fail during plasma arc cutting, the action statement of Technical Specification 3.3.1.1, "Neutron Monitoring," will be implemented. Specifically, action statement (b) requires that with no source range neutron monitoring channels operable: "...suspend all activities involving CORE ALTERATION, verify compliance with the boron concentration requirement of Specification 3.1.1.2 at least once per 24 hours by a mass balance calculation and at least once per 7 days by a chemical analysis and restore at least one source range neutron monitoring channel to operable status within 7 days. If not restored to operable status within 7 days, promptly, but not later than 30 days from loss of operability, prepare and submit a Special Report to the Commission pursuant to Specification 6.9.2, outlining the cause of the malfunction(s), the plans for monitoring the conditions of the core and the plans for resumption of activities involving CORE ALTERATIONS."

NRC COMMENT 3

How well will the alternate NI system be coupled with the fuel bearing region of the Reactor Vessel?

GPU NUCLEAR RESPONSE

In 1986, a technical evaluation (Reference 1) was performed to examine the nature and the causes of the signal response of the TMI-2 source range monitors (SRM), designated NI-1 and NI-2, for several defueling operations. The calculations for these analyses utilized with DOT 4.3, an industry standard neutron transport code (Reference 2). The analyses successfully predicted the actual SRM response (0.776 cps calculated versus 1.1 cps measured).

This same method has been used to provide preliminary estimates for the fission chambers designated as the alternate NIs. The geometry model used in the latest analysis simulates the current TMI-2 geometry. It is assumed that all fuel material has been removed from the core region of the Reactor Vessel. Fuel was located in three (3) regions of the model: 1) the Reactor Vessel lower head region, 2) the lower core support assembly region, and 3) behind the core baffle plates. Based on this geometry, GPU Nuclear plans to position the fission chambers inside the downcomer region of the Reactor Vessel. The instruments will extend down as far as physically possible into the region along the lower core support assembly.

Reference 3 transmitted preliminary estimates for the actual thermal flux in the downcomer which peaks at a height of approximately 105 cm relative to the outside surface of the bottom head of the Reactor Vessel. This location is near the lower region of the lower core support assembly and approximately corresponds to plant elevation 294'. The specifications of the Reuter Stokes fission chambers proposed to be used for the alternate NIs is provided in the response to Comment 1. Given the calculated thermal flux in the downcomer, the Reuter Stokes fission chambers are expected to be able to detect significant changes in the thermal neutron flux level in the lower head region of the Reactor Vessel. Revisions to station procedures may be made to reflect the thermal neutron flux level at which action to respond to changes in flux levels will be required.

REFERENCES

1. "Source Range Monitor Response to Fuel Distribution and Changes in Core Reactivity," A. J. Baratta, et. al., Pennsylvania State University, Department of Nuclear Engineering, (DRAFT Report).

2. W. A. Rhoades and R. L. Childs, "DOT 4.3, One-and Two-Dimensional Transport Code Systems," CCC-429, Radiation Shielding Information Center," Oak Ridge National Laboratory, April 1982.

3. Letter dated March 22, 1988, Prof. A. J. Barratta (Pennsylvania State University) to Mr. Dave Buchanan, TMI Nuclear Generating Station.